Instrument Accommodations

Actions:

- **Review instrument/technology development inputs in Reference Mission Description**
- **Work out high level instrument schedule**
  - Identify critical paths/milestones
  - Identify resources/funding profile to support critical paths
- **Assign representative from technology development team to Radiation Forum**

Instrument Accommodations

- **CCD/Gratings**
  - Mass
    - CCD: 20 kg
    - Gratings: 73.5 kg
  - Power for CCD:13.8 watts
  - Data Rate: 10.5 kbps (daily average); 300kbps (peak)
  - Special Accommodation Concerns
    - Magnetic Cleanliness
    - EMI/EMC
    - Radiation
    - Micro-phonics/Vibration
    - Contamination
  - Corrected illustration for gratings will be in next draft

Instrument Accommodations

- **X-ray Calorimeter**
  - Mass
    - Calorimeter assembly with ADR, electronics : 33.0 kg
  - Data Rate: 30 kbps (average); 1051 kbps (peak)
  - Special Accommodation Concerns
    - Magnetic Cleanliness
    - EMI/EMC
    - Radiation
    - Micro-phonics/Vibration
    - Contamination
  - Update to accommodations table and semi-conductor calorimeter description will be in next draft

Instrument Description

- **Hard X-ray Telescope**
  - Mass
    - Optics: 63 kg/per HXT assembly (3 per satellite)
    - Detector:11kg/per HXT assembly (3 per satellite)
    - Weight per satellite: 222 kg
    - NRA weight (adjusted for 4 satellites): 195 kg
  - Data Rate: 3 kbps (average); 14 kbps (peak)
  - Special Accommodation Concerns
    - Magnetic Cleanliness
    - EMI/EMC
    - Radiation
    - Micro-phonics/Vibration
    - Contamination

Strategy for a Radiation Hard Mission

- **Develop risk management approach early in mission**
  - Assess radiation environment
  - Identify device and system vulnerabilities
  - Make accommodations to design and operational approach to minimize risk
- **Near-term strategy**
  - Set up Radiation Forum: information network on radiation
    - Project Chair: Robin Mauk
    - Representative from each instrument/technology development team
    - Contacts from Chandra and relevant programs
    - Web site with information on radiation environment, system and device susceptibilities, links to useful radiation web-sites

Radiation Environment for Constellation-X

- **Science Mission at L2**
- **Transfer orbit include 3-5 phasing loops through Van Allen Belts (30 to 60 days)**
- **Models of environment are improving**
  - NGST models are updated from those used for MAP
- **Assume radiation effect of charged particles (protons and electrons) are omni-directional and isotropic**

Radiation Dose Per Year krads(Si)

Mission	Shielding	
	1 gm Al/cm^2	5 gm Al/cm^2
MAP (3 phasing loops)	4.11	0.67
NGST (no phasing loops)	2.75	0.4
COBE (90^o /900 km) 20% time in SAA	3.76	0.63
Geosynchronous (35,790 km)	2.3	0.7

Long Term Radiation Strategy

- **Radiation engineer for Constellation-X**
  - Define and evaluate hazards
  - Define requirements
  - Evaluate devise usage
  - Team with other designers to ensure radiation hardness
- **Responsible person for radiation design concerns for each instrument**
  - Define and evaluate radiation sensitivities of instrument systems and components
  - Keep an up-to-date parts list with information on radiation harness and parts processing
- **Regular Radiation Reliability Reviews**
  - Review panel made of radiation design experts, project and instrument representatives